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MAIL IMAGE PROFILING AND HANDWRITING MATCHING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority of U. S. Provisional Application 60/422,311 filed on October 30, 2002, which is herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] This invention relates generally to the detection of hazardous material and, more particularly, to the application of image processing to early detection of potentially hazardous material associated with mail collection or the collection of other objects.

[0003] Recently there has been increased awareness of the potential for large-scale introduction of hazardous materials, for example, biological organisms, to create chaos or to harm an intended set of victims. One potential delivery method that terrorists or other criminals utilize to deliver such hazardous materials is through the mail or other form of a delivery. In so doing, not only is damage incurred by the intended victims, but also by any set of potential victims that may be in a position of handling such objects as the mail during the delivery or distribution process.

[0004] There is currently technology available to law enforcement organizations for detecting the presence of chemical and biological threats. Such test materials generally are sensitive to specific hazardous materials and are utilized by directly putting them in contact with such hazardous materials.

Table 1: Detectable Image Characteristics List

Detectable Image Characteristics
Destination address Resolution
Barcodes (FIM, PLANET, POSTNET in one embodiment)
Return Address Determination
Envelope Size
Destination/Return Address Style
Clear Area Infringement
Destination Address Infringement
Stain
Postage Characteristics
Type
Excessive Postage
Restrictive Markings
Return address Resolution (including misspellings)
Envelope Characteristics
Handwriting Similarity

Mail piece characteristics requiring more sophisticated algorithms for detection are grouped into later phases for deployment.

[0037] Exemplary, but not limited to, image-detectable mail piece characteristics, addressing degrees of effectiveness and accuracy, development time, image type, and relative processing power required, as described herein below.

[0038] Handwriting Matching, the capability to analyze handwriting or hand-printing on mail images to determine similarity to that of other (evidence) documents, is potentially

- Excessive Postage - The following embodiments, but not limited to, can distinguish instances of probable excessive postage. An assessment of the extent and shape of the postage area may be obtained from image processing of the binary (bi-tonal) images. Combined with the neural net technology described above for determining Postage Type, this method could assess the probability of presence of multiple stamps. The result is a probabilistic indication of excessive postage.

A more precise determination of the postage amount on an envelope requires processing grayscale images in order to recognize in detail specific stamp images and their amounts.

8) Restrictive Markings - The possible presence of restrictive text such as the words "Personal" or "Confidential" may be detected by means of image character recognition. In some embodiments, the image processing could be performed at the remote image reading and processing system (RCR) 2. For handwritten marks, the detection would require handwriting analysis and may be more appropriately performed offline. For machine printed mail, optical character recognition results, usually obtained at the remote image reading and processing system (RCR) 2, enable searching machine printed text for keywords.

9) Clear Zone Infringements - Several embodiments, but not limited to, of methods for detecting Clear Zone Infringements are disclosed below. Referring to Figures 2 and 3, the bottom band of envelope images seen by the remote image reading and processing system (RCR) 2 is normally clear, as this is the area in which a (POSTNET) barcode 90 is printed after the remote image reading and processing (and video coding if applicable) is

Characteristic	Categories	Image Type	Detection Rate	Accuracy
4) Return-Address Style	• Not present	Bi-Tonal	Moderate	Moderate
	• Handwritten (any form)	Bi-Tonal	Moderate	Moderate
	• Hand printed	Bi-Tonal	Moderate	Moderate
	• Hand cursive	Bi-Tonal	Moderate	Moderate
	• Machine printed (any form)	Bi-Tonal	Moderate	Moderate
	• Machine solid	Bi-Tonal	Moderate	Moderate
5) Return Address Resolution	• Machine broken			
	• Machine dot-matrix			
	• Invalid address (\$IP+4 Directory)	Bi-Tonal	Moderate	Moderate
	• Invalid address (CPF Directory)	Bi-Tonal	High	High
	• Non-local return address	Bi-Tonal	Low (HW) Moderate (MP)	Moderate (HW) High (MP)
		Bi-Tonal	High	High

Characteristic	Categories	Image Type	Detection Rate	Accuracy
	• Postal Code (Zip) Match (against a list of ZIPS)	Bi-Tonal	Low (HW) - 5 digits Moderate (MP) to High - 11 digits	High
6) Envelope Size & Skew	• Envelope Length • Envelope Height • Envelope Skew	Bi-Tonal Bi-Tonal	High Moderate	High Moderate
7) Postage Characteristics	• Postage Type (Stamp, Metered, Pre-printed, Embossed) • Excessive Postage	Gray Bi-Tonal Gray	Moderate Moderate High	Moderate Moderate High
8) Restrictive Markings	Configurable list of keywords ("Personal", "Confidential", etc.)	Bi-Tonal	Low (HW) Moderate (MP)	Moderate (HW) High (MP)
9) Clear Area Infringement	• Destination Address Infringement	Gray	Moderate	Low

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Characteristic	Categories	Image Type	Detection Rate	Accuracy
	• Stain	Bi-Tonal	Low	Low
		Gray	Moderate	Moderate
10) Handwriting Matching	Similarity score (degree of similarity to image of evidence mail)			

Table Legend:

Image Type: Type of image required to support detection of the image characteristic:

Bi-tonal: Current bi-tonal images of the front of the envelope are usable  
 Gray: Grayscale images required  
 Color: Color images required

Detection Rate: An estimate of the frequency of false negatives - instances where a mail piece exhibits the characteristic but the system fails to detect and indicate it:

Low UP to 25% false negatives  
 Moderate Up to 15% false negatives  
 High Up to 5% false negatives  
 Very High Approximately 1% - 2% false negatives